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ABSTRACT

This symposium report presents the background, underlying assumptions, philosophy and goals, research design, sample, and results of an intensive three-year organizational study involving military, government and civilian organizations. The first paper, by S. B. Wells, discusses the organizational setting, approach and rationale of this research. The second paper, by L. R. James, presents an organizational model developed to guide the investigation and specific analyses in the present study, and combines an open systems approach with a linkage model. The third paper, by A. P. Jones, presents empirical evidence bearing upon the theoretical model. The paper by E. K. Sunderson discusses aspects of the physical environment and their relationship to perceptions of the environment and to behavioral outcomes such as illnesses and accidents. The discussants, Paul Nelson and B. V. H. Gilmer review the study in terms of both its applied and theoretical applications. (Author/HMV)

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20 ABSTRACT (Continue on reverse side if necessary and identify by block number)

This symposium presented the background, underlying assumptions, philosophy and goals, research design, sample, and results of an intensive three-year organizational study involving military, government and civilian organizations. The first paper by S. B. Sells, discussed the organizational setting, approach, and rationale of this research, which embraced both macro- and micro-aspects of organizational situations, the characteristics of organizational subsystems, and the effects of organizational

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structures and events upon individual attitudes and performance. At the level of practical goals, all effort has been made to explain various differences in health rates within and across classes of ship, that were found in a previous study of illness rates at U.S. Navy installations.

The second paper, by L.R. James, presented an organizational model developed to guide the investigation and specific analyses in the present study. The model combines an open systems approach with a linkage model, and embraces a number of major facets of organizational functioning (Context, structure, values, processes) and organizational levels (external environment, total organization, subsystems,and groups). In addition, individual characteristics and intervening variables such as perceived organizational climate occupy significant roles in the model. This paper presented data on reliability, item analysis and dimensionality of an organizational climate questionnaire, as well as measures of structure and other organizational characteristics.

The third paper, by A. P. Jones, presented empirical evidence bearing upon the theoretical model. Analyses addressed relationships among variables within basic organizational or subsystem components (between structural variables), across components but within particular levels of analysis, across components and across levels, and finally predictive relationships with individual and organizational criteria.

The paper by E.K.E. Gunderson discussed aspects of the physical environment and their relationship to perceptions of the environment and to behavioral outcomes such as illnesses and accidents. Several environmental dimensions have been isolated and were related to differences in organizational units and to differences in illness and injury rates. Environmental characteristics were shown to affect health, job satisfaction, and work efficiency and to be separate from the effects of individual characteristics or organizational climate.

The discussants, Paul Nelson and B.V. H. Gilmer reviewed the study in terms of both its applied and theoretical implications.

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MEN IN SOCIAL SYSTEMS:
RESULTS OF A THREE-YEAR MULTIORGANIZATIONAL STUDY

Papers Presented at
American Psychological Association
New Orleans, August, 1974

Chair. Bert T. King, Ph.D. (ONR)

Presentations by: S. B. Sells, Ph.D.
Lawrence R. James, Ph.D.
Allan P. Jones, Ph.D. (IBR)
E. K. Eric Gunderson, Ph.D. (NMPRU)

Discussants: Dr. Paul D. Nelson, Commander, MSC
(Bureau of Medicine & Surgery)

B. von Haller Gilmer, Ph.D.
(Carnegie-Melon University)

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TABLE OF CONTENTS

HISTORICAL PERSPECTIVES AND DESIGN OF A SOCIAL SYSTEMS RESEARCH STUDY

S. B. Sells

The purpose of this introductory discussion is to outline a contextual framework in which the following presentations by my colleagues in this Symposium will be identified as functional components of a common enterprise. After reading their papers I realize that in their respective efforts to maximize the time available for substantive discussion they have left me two important tasks. The first is that of explaining the collaborative three-year study of Navy personnel in which the NMPRU at San Diego and the IBR (TCU) at Fort Worth have been partners. This explanation includes the theoretical orientation as well as the goals and overall design of the investigation. The second is that of clarifying the relation of the presentations this morning to the entire study. As I will try to explain, this is a progress report and not a final report. Its purpose is mainly to explicate the theoretical models used, the data gathered, and the types of analyses involved.

The three-year study involves a large-scale field investigation of Navy ships and shore installations. Its objectives involve substantive problems at two levels. At the level of social science research they involve developmental efforts to implement a broad social system model, encompassing environmental and organizational factors, as well as individual characteristics, for the study of individuals in organizations. At the level of applied social psychology or personnel psychology, they represent a research effort to account for increased portions of variance in measures of personnel effectiveness through the incorporation of environmental and organizational measures implied by the social system model. The compatibility of the theoretical and applied

goals reflects well the quality and the broad interests of the members of the research team and is responsive to the concerns of the sponsor, the Office of Naval Research, to emphasize practical as well as theoretical relevance in its supported program. The papers that follow reflect this dual concern.

The historical perspectives implied in the title of this paper are personal as well as substantive since the initial planning, by Eric Gunderson and me represented the convergence of activities which we had pursued separately and finally in collaboration since the early 1960's. As a senior member of the NMPRU staff, Gunderson had long been engaged in the search for factors that explain and predict noneffectiveness of Navy personnel, such as illness rates, job dissatisfaction, absenteeism, premature attrition, and others. This search, as we have reported elsewhere (Gunderson and Sells, 1974), led increasingly to the conviction that significant and indeed, major sources of the behavior patterns related to the effectiveness - noneffectiveness dimension reside in circumstances of living and working and extend beyond the domain of individual characteristics, the traditional source that has been mined almost to the point of depletion.

Recent Navy studies aboard Navy combat vessels (cruisers, aircraft carriers, and a battleship) during overseas deployments and with Naval aviators during carrier combat operations, (Gunderson and Rahe, 1974), (Rahe, Gunderson, Pugh, Rubin, and Arthur, 1972), (Rubin, Gunderson, and Arthur, 1972), had shown consistent relationships between illness rates and such factors as ships' operational activities, work conditions, demographic characteristics of crew members (which are ascriptive rather than personal measures), and recent life stresses. One salient result was that men working in physically demanding and hazardous environments had relatively high illness rates. Another was that illness rates among men in "blue-collar" jobs (ordnance, deck, and

engineering) were higher than those among men in "white collar" office and technical jobs; similar results had been reported in civilian industry. Of particular interest was the observation that overall illness rates varied considerably among ships (McDonald, Pugh, and Gunderson, in press).

The substantial differences in illness rates among ships were analyzed in terms of differences in operational schedules, crew composition, and illness reporting procedures, with rather disappointing results, and it was hypothesized that a combination of environmental conditions (habitability) and organizational or social context variables, as well as interactions among these factors, would account to a greater extent for the variations in morbidity rates aboard the ships studied. Further research was needed to determine possible sources of variation in illness rates among ships and other types of organizations; if conditions could be identified which were associated with high illness rates and poor morale, appropriate corrective or preventive measures might be devised.

A conceptual model for such further inquiry, that could embrace a broader range of effectiveness and effectiveness-related criteria, was developed out of a collaborative effort by Gunderson and me to provide a context for the study of similar problems in relation to long-duration space missions. The occasion was the assignment to prepare a portion of the report of the NAS Committee on Long Duration Space Flight and the result, published in that report; was entitled A Social System Approach to Long Duration Missions (Sells and Gunderson, 1972). This statement was an elegant and well-documented elaboration of an earlier paper (Sells, 1966) in which I had proposed a social system model for organizational research and applied it to a variety of small organizations that function in isolated circumstances. The major components of this model, which were supported by detailed subcomponent

descriptors, proved to be particularly useful for taxonomic analysis. They were 1. goals and objectives, 2. philosophy and value systems, 3. personnel composition, 4. organization, 5. technology, 6. enveloping environment, both physical and social-cultural, and 7. temporal factors.

The original concerns that led me to the concept of an organization as a type of social system, were three. First, I have for many years been interested in the study of behavior as organization-environment interaction and the concept of social system emerged after many false tries as a device for representing the environment in a formulation reflecting its organization as it affects the individual. Second, I reached the conviction, not yet substantiated by extensive empirical analysis (for which support is hard to find) that a typology of organization social systems is feasible and would go far toward furthering understanding of behavior in organizations. Third, and finally, this approach provided a promising and well organized agenda for the study of environmental factors that account for behavior variance. Some of the research presented today supports this expectation.

Gunderson and I agreed that the generality of the social system model made it applicable to organizations of all forms, including ships, and we formulated the initial plans for this study in terms of the major components that I have enumerated. With the background of epidemiological research mentioned earlier, ONR was asked to support an intensive study of some of the determinants of illness rates and other forms of performance ineffectiveness in individuals and groups aboard naval ships and shore stations. A small sample of civilian organizations was included for comparative purposes. This three-year research program, primarily concerned with environmental and organizational characteristics that affect health and morale and jointly sponsored by the Bureau of Medicine and Surgery and the Office of Naval Research, is now in its third year.

A study of this scope required diverse professional talents. Major roles have been assumed by Dr. Allan P. Jones of IBR, Dr. Lawrence R. James, who transferred from NMPRU to IBR last year, Dr. Blair W. McDonald, formerly of NMPRU and presently with the General Motors Corporation, Detroit, Michigan, and Lt. Larry Dean of NMPRU. The supporting staffs at both organizations cannot be mentioned here, but deserve high credit for their outstanding work.

The study has involved three phases. The first phase was a pilot study of 13 Navy ships and 1,200 crew members, concerned mainly with development, testing, and revision of research instruments. The second, the major data collection phase, covered a large sample of organizations, including shore stations and civilian organizations; 20 Navy ships and 6,000 crew members have participated in this part of the study. Questionnaires, interviews, on-site observations, and personnel and organizational records have been gathered by research teams aboard ships under operational conditions and at selected shore facilities. Approximately half of these units participated in a second round of data collection after an interval of four to six months in order to provide longitudinal data on major variables. The third phase, concerned with data analysis and interpretation, will conclude with final reports, presenting findings and recommendations to the Navy and technical publications in the open literature.

The data collected cover a number of domains related to the social system model: measures of the physical environment aboard ship, habitability perceptions, organizational climate, biographical data, job motivation and satisfaction, personnel data, sick call records, organizational structure, and leadership information.

In view of the two levels of conceptual relevance of this study it is important to note that many of the variables represented in the data matrix

were selected to relate the present investigation to significant developments reported in the literature. In addition, the selection and ordering of data were guided by a process model of organizational behavior and effectiveness developed by James and Jones within the social system framework (James and Jones, 1974, a, b, c). This model proposes that behavior in organizations is a complex function of intraindividual characteristics, external influences, and interactions of subsets of both. It views individual behaviors and attitudes, for example job satisfaction, as a joint function of subsets of individual characteristics and subsets of variables representing the organizational situation. The model will be explicated by Dr. James who will also review the research on the development of complex measures to represent several major components, particularly psychological climate and subsystem structure.

Dr. James' paper thus focuses on analyses within major components represented in the model. Some relations between components, at the level in which the individual seaman is the unit of analysis will be presented by Dr. Jones. The empirical data presented in both papers represents a very sizable effort, but at the same time, only a portion of the total. The IBR staff have dealt mainly with organizational data. The NMPRU staff have organized and reduced the environmental and habitability data and Dr. Gunderson will report on these. Dr. Jones will relate, as part of his presentation, some relations of individual and organizational variables with one group of criteria, promotion rate, intent to reenlist, and satisfaction. Dr. Gunderson will relate the environmental data to health indices.

These selected analyses give a broad cross-sectional insight into the data that are presently entering the final stages of analysis in which the major organizational, environmental, and criterion component measures,

developed separately by the IBR and NMPRU staffs, will be merged to carry out the overall objectives of the study. In this final stage the data will be analyzed at one level in which individual seamen will be the unit of analysis and at another in which organizations (ships) and major organizational divisions of organizations will be the unit of analysis. An important feature of this study involves the use of organizational and environmental data in analyses of individuals.

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AN ORGANIZATIONAL MODEL: COMPONENTS AND MEASUREMENT

Lawrence R. James and Allan P. Jones

Introduction

A strong plea has been made to develop new models for organizational research which encompass both individual and situational characteristics as antecedent causes of individual behavior and attitudes in organizational settings (Campbell, Dunnette, Lawler, & Weick, 1970; James, 1973; Lichtman & Hunt, 1971; Sells, 1963). One identifying feature of these proposed "integrating" models is that behavior and attitudes are seen as related either to the additive and linear aspects of individual and situational characteristics or to the interaction between individual and situational characteristics. Examples of integrating models include open system and role models (Homans, 1950; Kahn, Wolfe, Quinn, Snoek & Rosenthal, 1964; Katz, 1964; Katz & Kahn, 1966; Katzell, 1962; Sells, 1963), the contingency model of leadership effectiveness (Fiedler, 1967, 1971), a criterion model for managerial effectiveness (Campbell et al., 1970; James, 1973), and an organic-adaptive model for future organizational functioning (Bennis, 1969).

The advent of integraing models requires the development of rationale and methodology for measuring both macro and micro situational characteristics in organizations. Psychologists have generally concentrated their situational research on the micro aspects of organizations, principally at the individual and intermediate work group levels (Katz & Kahn, 1966). Secondly, there has been a tendency to make global assumptions about organizational structure or to disregard it altogether (Lichtman

& Hunt, 1971; Porter & Lawler, 1965). On the other hand, sociologists, political scientists, management scientists, economists, and others have adopted a "macro" approach, investigating the dimensions and effects of large organizational subsystems and total organizations. Both approaches have weaknesses. The weakness of the psychological emphasis on micro levels is the present lack of knowledge regarding how characteristics of organizational levels above the immediate workgroup influence behavior and attitudes (Blankenship & Miles, 1968; Herman & Hulin, 1972; Porter & Lawler, 1965; Prien & Ronan, 1971). On the other hand, the macro approach has neglected the effects individuals may have upon the organization. As emphasized by Katz and Kahn (1966), both the macro and micro aspects of organizations must be investigated if organizational researchers are to understand the relationships between organizational situations and individual behavior and attitudes. A combination of these approaches requires the addition of more levels of analysis (e.g., subsystems, total organizations, and the sociocultural environment), the identification of general aspects of social situations, and the study of adaptive and dynamic organizational processes.

This paper presents an organizational model that was designed to encompass the related concepts of integrating models, dynamic models, and open system models as well as micro and macro organizational variables. Major levels, components, and either empirically demonstrated or hypothesized relationships within or among components are discussed. Results obtained from several intra-component analyses are also presented; however, the majority of analyses and results using the proposed model as a guide are presented in the next paper.

Proposed Organizational Model

The proposed organizational model is presented in Figure 1 of the handout. An elaboration of the situational components is presented in Figure 2. It must be mentioned that the model is a preliminary step in the development of an integrating-open system model. As such it is considered neither exhaustive nor definitive.

Components (e.g., squares) of the model include the sociocultural and external physical environments; the total organizational context, structure, systems values and norms, process, climate, and physical environment; psychological climate; organizationally related attitudes and motivation; individual resources; individual job behaviors and job performance; and end-result criteria. As shown at the bottom of Figure 1, the components are further categorized as situational (to the left of the vertical dotted line), intervening, individual characteristic, and individual behaviors and criteria. Organizational criteria were not included in the model because they could be constructed for any number of group, subsystem or organizational measures.

While a full presentation of the model was not feasible here, each component is briefly described and discussed. A more in-depth discussion of selected components follows the overview of the model. The sociocultural environment includes attributes such as the social, linguistic, technologic, and aesthetic culture that provide an external context and cultural frame of reference (Sells, 1963). The external physical environment encompasses measures related to geographic location such as temperature, noise, and environmental hazards. With respect to components of the organizational situation, context at the organizational, subsystem and group levels refers to the history, development, goals dependence, and technology of a

particular organization, subsystem, or group; it provides a history, rationale, and transition for the organizational entity (Pugh, Hickson, Hinings, & Turner, 1969).

Structure at the various organizational levels was defined as:

> The enduring characteristics of an organization or organizational subsystem reflected by the distributation of units and positions within the organization or subsystem and their systematic relationships to each other.

This definition was predicted upon those presented by Porter and Lawler (1965), Ghiselli and Siegel (1972), and Pugh, Hickson, Hinings, and Turner (1968). Based upon a review and integration of the literature, we have (James & Jones, 1974) proposed seven descriptive dimensions of structure, which are presented in Figure 3. These dimensions, which are not considered to be homogeneous in the sense of one factor not mutually exclusive, include: 1) size, 2) centralization of decision making and authority, 3) configuration, 4) formalization, 5) specialization, 6) standardization, and 7) interdependence of organizational units.

Systems Norms and Values concern the explication of appropriate organizational, or group, behaviors and the ideology to reinforce such behavior (Katz & Kahn, 1966). Included within this component are such measures as conformity, impersonality, reciprocity, and so forth.

Process at the various organizational levels is defined in Indik's (1968) terms. That is, process encompasses variables that maintain the system in a steady state of that deal with the adjustment processes that are mobilized to maintain a steady state. Although obviously related, a conceptual distinction between structure and process was provided by Sells (1968) who described structure as reflecting the broad dimensions of social situations in which people interact, and process as modes of interaction

exemplified by behavior and organizational states.

The physical environment includes physical space characteristics (temperature, light), habitability, and variables such as remoteness, hazards, confinement, and endurance demands.

Organizational climate or OC is defined here as a set of second order abstractions of intervening variables or first order constructs representing prevailing conditions of the organizational environment as related to characteristics of the job, the leadership, the workgroup, and the various subsystems as well as the total organization. Organizational climate is differentiated from psychological climate or PC in that OC refers to organizational attributes, main effects, or stimuli (Campbell et al., 1970; Forehand & Gilmer, 1964; Guion, 1973), while PC refers to individual attributes, namely the concept of an intervening psychological process based upon perceptions. The perceptions are considered internal representations of the organizational environment based upon an interaction between actual organizational characteristics and individual characteristics (Friedlander & Margulis, 1969; Schneider, 1972, 1973; Schneider & Hall, 1972). The definition of PC is similar to that of OC in that it is also conceptualized as a set of second order abstractions. However, as discussed above, the properties of OC and PC differ significantly in many ways, the most important of which is the difference between an organizational attribute and an individual attribute (James & Jones, in press). Thus, psychological climate is defined as a set of second order abstractions of intervening variables or first order constructs which are based upon internal representations of the organizational environment as related to characteristics of the job, the leadership, the workgroup, and the various subsystems and the total organization.

The organizationally related attitude and motivation component includes measures such as job satisfaction and various expectancies, instrumentalities,

and valences (e.g., components of a VIE model). This component is considered to be both an individual characteristic and an intervening measure in the sense that variables included in this component are relatively susceptible to change as a function of experiences in the organization, and secondly, they provide an operationalization of the intervening psychological process as discussed by Indik (1968) and Likert (1961). The individual resources component on the other hand includes variables such as intelligence, aptitudes, personality, race, socioeconomic status, etc., which are somewhat less susceptible to change and thus are considered as individual characteristics. Individual job behaviors and job performance follow models presented by Campbell et al. (1970) and James (1973), and represent the actual things people do on their jobs (behavior) that are organizationally relevant and measurable (performance). Finally, the end-result component includes criteria such as promotion rate, productivity indices, turnover rates, salary progression, etc., which are a function of job performance as well as situational measures beyond the control of the individual (Campbell et al., 1970), thus the dotted line from the situational component to this component was required.

The relationships between components are exemplified by a series of embedded levels of situational variance (e.g., organization, subsystem, and 1...k groups), one-way and two-way arrows representing a logical flow of events and feedback, and interaction symbols (crossed arrows). The embedded levels of situational variance reflect the idea that situational components are interrelated; although, the embeddedness was not mean to imply that the relationships need necessarily be direct nor large. Two-way arrows and arrows moving from right to left reflect the ideas of feedback and dynamicity

and thus the need for longitudinal analysis. The interaction symbols reflect the concepts that a) the relationships between situational measures and intervening variables may partially be a function of situation-situation, individual-individual, or individual-situation interactions, and b) the prediction of job performance and end-result criteria may require perception-attitude-individual resource interactions, with the direct addition of situational measures to the above interactions in the case of individual end-result criteria. Finally, as discussed below it is expected that the effects of the external environment or organizational level components upon the intervening or individual components would normally be mediated by subsystem and group variables. A similar mediation would also be expected for individual influences upon the organization. However, the model does allow for those cases in which the more macro characteristics of the situation have a direct influence on, or are directly influenced by, the intervening or individual variables.

In much the same vein as Indik (1965), the above model postulates that the relationships between nonadjacent variables in the model may likely require the use of a linkage analysis. That is, the relationships between the structure and attitude components.

Preliminary Data Analyses

The present study focused upon selected components of variables within components. The data analyses to be described here concern attempts to identify variables and/or dimensions related to subsystem structure and psychological climate. Variables representing subsystem process are also indirectly addressed.

Psychological Climate (PC). Psychological climate was defined as a set of second order abstractions of perceptual descriptions of the

organizational environment. The assumed properties of PC were that it is an individual attribute, it represents an intervening psychological process, and it may be based upon an individual-situational interaction.

We have attempted to address the conceptual bounds of PC (James & Jones, in press) as well as the criticisms that climate is tautological with known situational, job characteristic, or job satisfaction variables (Guion, 1973; Johannesson, 1973) with this very preliminary definition. In essence, we have attempted to construct a theoretical nomological net for PC. Of concern now are the attempts to construct an empirical net.

The concept of a second level abstraction requires explanation. I will use nomological net terminology (Cronbach & Meehl, 1955; Feigl & Scriven, 1956; Royce, 1963) for this explanation. At the data or P-plane we have a large number of micro perceptions of the organizational environment, including perceptions of the job, leadership, reward structure, etc. Operationally, we think of individual items in a climate questionnaire, each of which addresses a micro aspect of the organizational environment.

Composite variables are viewed as first order abstractions or intervening variables (in some cases they may be explanatory to the degree to be regarded as constructs). Here we find many of the measures frequently employed in industrial or organizational psychology. These include: job related measures such as role ambiguity, job challenge, and job autonomy; leadership related measures such as support and goal emphasis; workgroup related measures such as cooperation and esprit; and subsystem or organizational measures such as openness of expression, cooperation, and opportunities for growth and advancement. You will note that these measures are frequently based on factor or component analyses of items.

Psychological climate is then viewed as a set of second order abstractions of the composite (first order) variables. Psychological climate is therefore a more parsimonious and explanatory description of the situation than the first order variables. Second, climate when conceptualized in this manner is not tautological with known situational variables (e.g., composite variables). Finally, although climate and organizational related attitudes, namely job satisfaction, are shown to be dynamically related in the model, they are conceptually distinct, one (climate) representing a perceptual description of the situation and one representing a personalistic reaction (emotion) to the situation (Locke, 1969). Finally since PC is an individual attribute, there is no requirement that members within a particular group agree in their perceptions of climate; although, consensus of opinion is certainly not precluded.

With respect to an empirical analysis of PC, Table 1 presents the component structure and reliability estimates for 35 intervening variables or first order constructs arranged by four organizational levels. The first order measures were based upon unit weighted item composites, with an average number of four items per composite. You will note that many of these measures represent well known job, leadership, workgroup, etc., measures, typically based upon some form of accumulation of micro perceptions of prevailing conditions in the organizational environment. Thus, they were conceptualized as first order abstractions. As discussed, PC was conceptualized here as more broad, explanatory, parsimonious, and abstract than the first order measures. Thus, the first order measures were subjected to principal components analysis to arrive at second order abstractions.

The data presented in Table 1 were obtained for a sample of 4315 Navy enlisted personnel. The six components with eigenvalues greater than or equal to one accounted for 59 percent of the trace of the correlation matrix. The designations given to the components were: 1) Conflict and Ambiguity; 2)

Challenge, Importance, and Variety of the Job; 3) Leader Effectiveness; 4) Workgroup Cooperation, Friendliness, and Warmth; 5) Professional and Organizational Esprit de Corps, and 6) a weak component for Job Standards and Pressure.

Table 2 presents preliminary examinations of component invariance for the PC components for the Navy sample, a sample of firemen (N=398), and a sample of lower management to top regional management in a private health care foundation (N-504). Six components were also found for the same 35 first order measures in each of the two latter samples. Sixty-three percent and 67 percent of the trace was accounted for, respectively. Examination of the results in Table 2, which are based upon coefficients of congruence (Tucker, 1951; Mulaik, 1972), indicated that five of the six Navy components tended to be generalized in the two other studies. This speaks rather favorably for component invariance, construct validity, etc.; however, all was not rosy as several nuances were also observed. For example, all of the first order organizational measures loaded above .40 on one component in the health management sample, indicating some lack of differentiation, if in fact such existed. Second, a component reflecting confidence and trust displayed by the leader toward his subordinates was found in the health management and firemen samples (coefficient of congruence equals .81). In general, however, five of the six PC components appeared to generalize across samples, which privided at least partial support to our reification of the construct of psychological climate.

Subsystem structure. The seven proposed dimensions of structure proposed in Figure 2 were based upon a review and integration of the literature (James & Jones, 1974b), with emphasis placed on Pugh et al., (1968). The proposed dimensions represent a desire to postulate underlying intervening variables or constructs and then to operationalize the dimensions through variables. The dimensions were not considered to be independent or orthogonal in a mathematical sense, but rather to differentiate among sets of conceptually homogeneous variables.

Table 3 presents the results of a principal components analysis of variables representing the structural dimensions of standardization, centralization, formalization, and dependence. The data were obtained from questionnaires administered to division and department heads aboard Navy ships (N=316). The results reported in Table 3 provided support for the differentiation among the four structural dimensions. Simple structure was quite evident, and variables hypothesized to represent specific dimensions defined either one or two homogeneous components. The seven components were designated, 1) General Centralization of Decision Making, 2) General Standardization, 3) Interdependence Among Organizational Units, 4) Formalization of the Role Structure, 5) Centralization of Work Scheduling and Allocation, 6) Formalization of Communication, and 7) a weak component reflecting Standardization of Procedures for Expending Funds.

Table 4 presents correlations among component scores for the above components of structure and variables representing the remaining three proposed structure dimensions, namely size, specialization, and configuration. Data for the latter three dimensions were obtained from ship records, namely manning guides. The correlations were based upon data for divisions, which were also representative of departments.

Inspection of Table 4 demonstrates that size correlated moderately with the specialization variable. Second, the span of control tended to be higher in the larger divisions, and the larger divisions had more levels. Specialization did not correlate significantly with span of control, but had a low, significant correlation with the number of levels in the organizational hierarchy. The two configuration measures had a low but significant correlation. Finally, the correlations among the component measures, size, specialization, and configuration were generally low and not significant.

These results provide at least partial support for the proposed seven dimensions of structure. However future research is obviously needed.

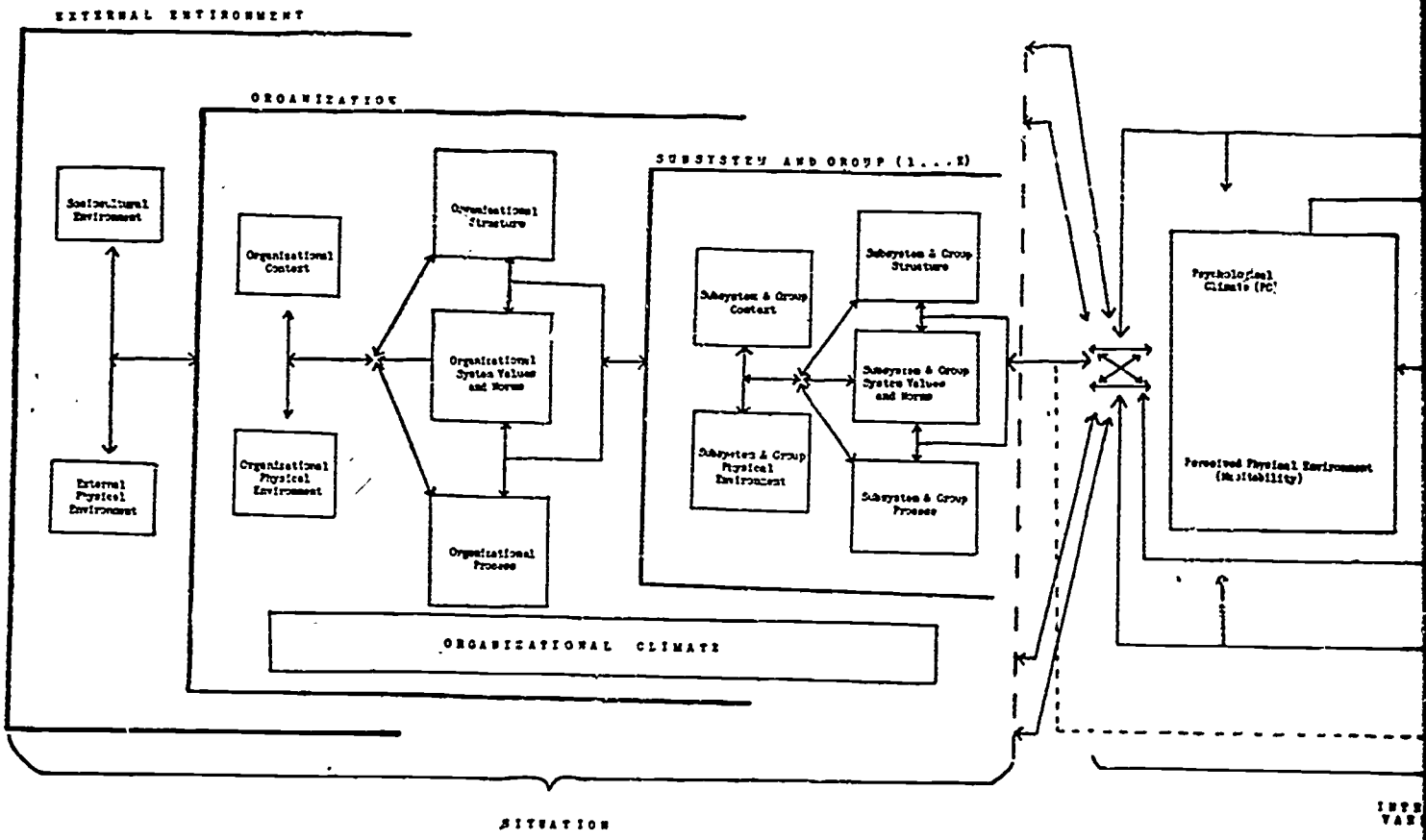

FIGURE 1. A MODEL OF ORGANIZATIONAL FUNCTIONING
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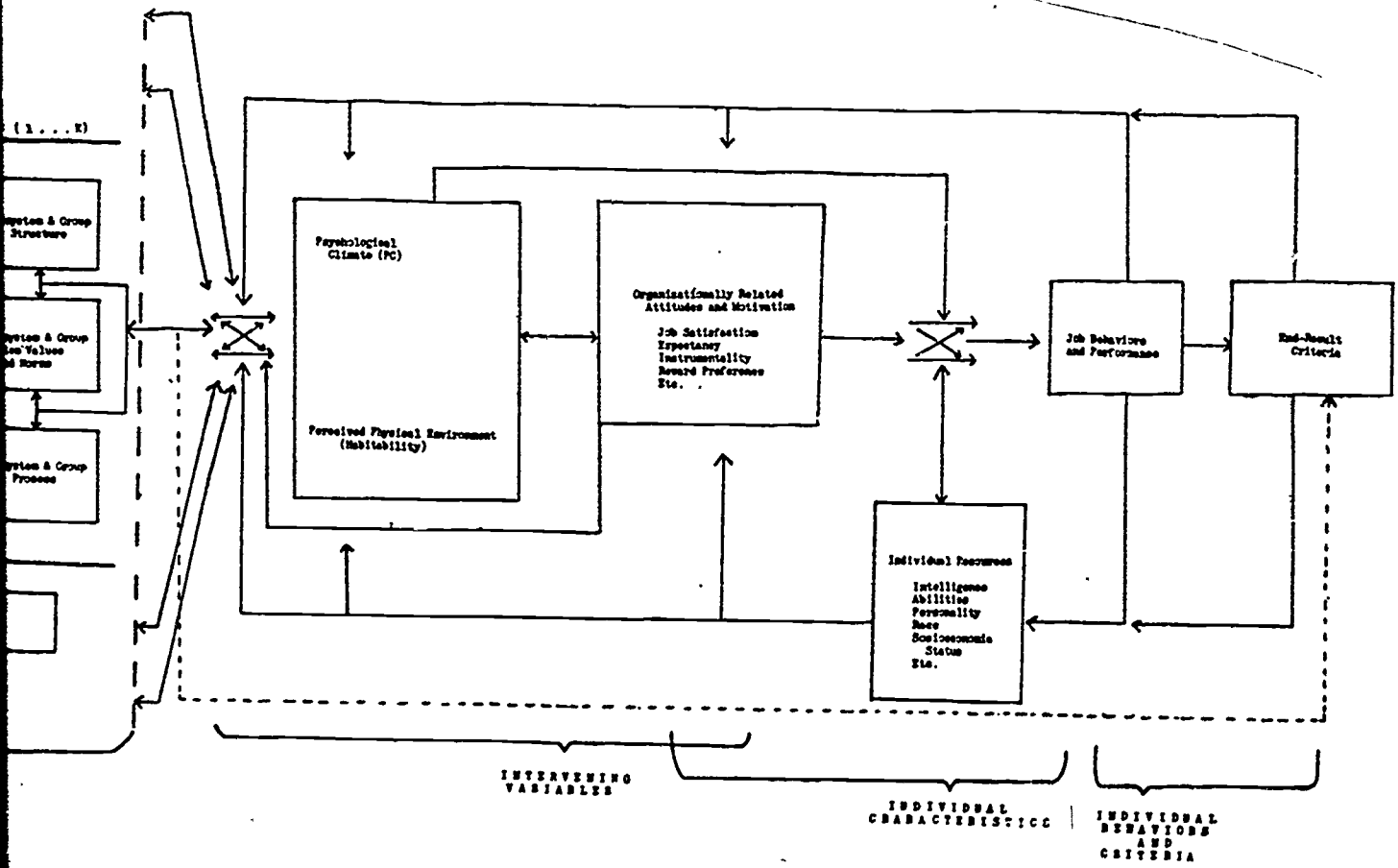

1. A MODEL OF ORGANIZATIONAL FUNCTIONING
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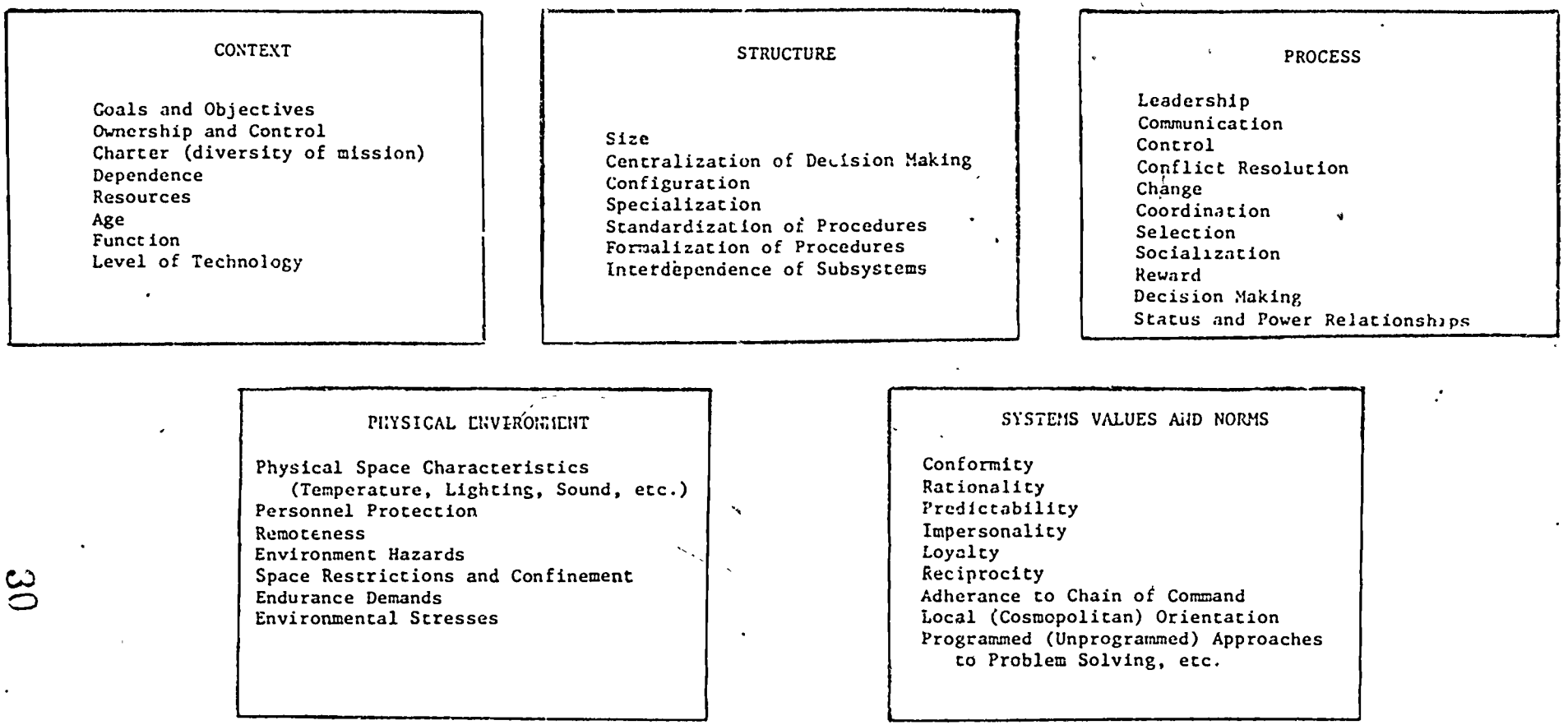


Figure 2. Components of situational variance in the total organization, major subsystems, and 1...k groups.

Table 1

Principal Components of Psychological Climate for U. S. Navy Enlisted Personnel

Intervening Variables or First Order Constructs	Components							
Job or Task	1	2	3	4	5	6	h^2	Cronbach Alpha
1. Role Ambiguity	.48*	-.44					.62	.62
2. Role Conflict					-.49		.59	.58
3. Job Autonomy		.52					.66	.68
4. Job Variety		.67					.59	.68
5. Job Importance		.68					.61	.65
6. Job Feedback		.46	.51				.55	.52
7. Job Challenge		.75					.69	.77
8. Job Pressure					-.53	.40	.59	.54
9. Efficiency of Job Design	-.46						.47	.46
10. Job Standards		.42				.54	.60	.52
11. Opportunity for Dealing w/Others		.54					.33	.47
Leadership								
12. Support			.72				.78	.81
13. Goal Emphasis			.72				.69	.62
14. Work Facilitation			.80				.79	.73
15. Interaction Facilitation			.77				.73	.70
16. Planning and Coordination			.61				.65	.56
17. Upward Interaction			.50		.48		.50	.47
18. Confidence and Trust - UP					.61		.49	.50
19. Confidence and Trust - Down						.40	.54	.52
Workgroup								
20. Cooperation				.75			.74	.73
21. Friendliness and Warmth				.72			.65	.63
22. Reputation for Effectiveness				.59			.58	.54
23. Workgroup Esprit de Corps				.64			.63	.70

* Only measures with loadings $\geq |\pm.40|$ are presented.

Table 1 (Continued)

Intervening Variables or First Order Constructs	Components							
Organization	1	2	3	4	5	6	h^2	Cronbach Alpha
24. Openness of Expression					.64		.64	.70
25. Organizational Communication - Down	-.55						.62	.68
26. Interdepartmental Cooperation	-.57						.37	.56
27. Conflict of Org. Goals and Objectives	.66						.57	.55
28. Ambiguity of Org. Structure	.66						.58	.44
29. Consistent Applications of Org. Policies	-.47				.45		.46	.47
30. Organizational Esprit de Corps					.66		.61	.61
31. Professional Esprit de Corps					.79		.67	.67
32. Planning and Effectiveness	-.53						.56	.54
33. Fairness and Objectivity of the Reward Process	-.51						.40	.53
34. Opportunities for Growth and Advancement				.57			.62	.63
35. Awareness of Employee Needs and Problems	-.41			.52			.54	.56

Table 2

Coefficients of Component Invariance for Psychological Climate

	Components								
	Leadership Effectiveness			Workgroup Cooperation, Friendliness & Warmth			Conflict and Ambiguity		
	1	2	3	1	2	3	1	2	3
1. Navy Enlisted	--			--			--		
2. Health Mgt.	.97	--		.91	--		.75	--	
3. Firemen	.96	.96	--	.87	.90	--	.93	.74	--

	Professional and Organizational Esprit de Corps			Job Challenge, Importance, and Variety		
	1	2	3	1	2	3
1. Navy Enlisted	--			--		
2. Health Mgt.	.83	--		.77	--	
3. Firemen	.90	.77	--	.89	.89	--

Table 3

Principal Components for Four Proposed Dimensions of Subsystem Structure[1]

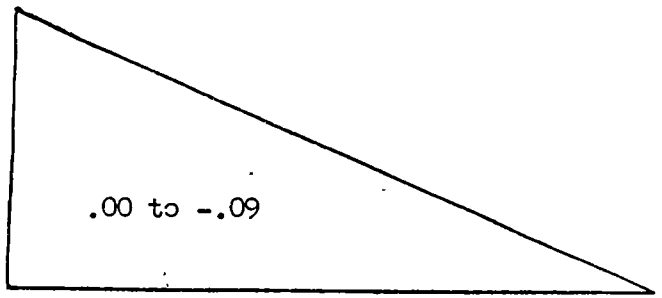
Variables	Components 1	2	3	4	5	6	7	h^2
Formalization								
1. Job responsibilities are defined				.85*				.75
2. Activities specified in writing				.84				.73
3. Emphasis on written communication						.79		.72
4. Must follow chain of command						.59		.58
Standardization								
5. Procedures for and frequency of inspections		.48						.42
6. Reporting performance		.57						.37
7. Procedures for discipline		.48						.42
8. Initiating of meetings and formal activities		.74						.57
9. Expenditure of funds							.87	.79
10. Training personnel		.59						.46
Dependence								
11. Depend on other units for resources			.70					.51
12. Consider other units' needs in preparing work schedules			.70					.52
13. Joint decision making bearing on own act			.70					.56
Centralization of Decision Making								
14. Determine own budget[2]	.52							.40
15. Allocate work					.82			.74
16. Determine work schedule					.80			.74
17. Adopt new program or policy	.67							.47
18. Set standards of performance	.70							.53
19. Set overall goals	.77							.61
20. Autonomy in making decisions	.66							.52
21. Determine methods for goals and activities	.48							.34

1 = percent of trace accounted for = .56
2 = A high score reflects high centralization
* Only loadings $|\pm .40|$ are presented

Table 4

Correlations Among Structure Variables for Divisions

Variables	Correlations										
	1	2	3	4	5	6	7	8	9	10	11
Size											
1. Size of Division	--										
Specialization											
2. No. of Occupational titles per division	.39**	--									
Configuration											
3. Span of Control - Workgroups [1]	-.32**	-.03	--								
4. No. of Levels in Division	.55**	.30**	-.19**	--							
Component Scores											
5. Overall Centralization	.05	.00	-.09	.01							
6. Overall Standardization	.08	.02	-.14*	.07							
7.	.11	.05	.03	.07							
8. Formalization of Role Structure	.14*	-.06	.02	.09							
9. Centralization of Work	.20**	.10	-.07	.16*							
10. Formalization of Communication	.06	.01	.09	.17**							
11. Standardization of Training	-.01	-.03	.03	-.07							



*p <.05=.13, N=241-281

**p< .01=.17

[1]Low Score=high span

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AN ORGANIZATIONAL MODEL: EXPLORATORY ANALYSES

Allan P. Jones and Lawrence R. James

My presentation continues the discussion of the organizational model, exploring some of the relationships implied in that model (James & Jones, 1974).

The paper is organized around two basic levels of analysis: 1) the individual level and 2) the organizational level. On the individual level, the specific relationships to be examined are those among selected subsystem variables, individual characteristics, perceptions, attitudes and behavior. The organizational level analyses address relationships among structure and context, subunit climate and subsystem performance. A general linear model is used to investigate components and interactions within and among components.

Psychological Climate

At the individual level of analyses, an important domain would appear to be the individual's internal representation or perception of the environment in which he works (Schneider, 1972, 1973a, 1973b; James & Jones, in press). In the present model, this internalization is represented by the psychological climate (PC) component.

The first set of analyses, attempted to explore the relative importance of individual characteristics versus situational influences upon PC. As in James' presentation, the situational analyses emphasized the structural component and interactions among variables within that component. Nevertheless, selected variables from other subsystem components (context, process) are also included. The discussion is limited to the sample of U. S. Navy enlisted men and to the subsystem level of division. Due to missing data for

some divisions, the N for these analyses were reduced to 726 (compared to 315 for James).

Situation. Table 1 presents the variables used in the situational analyses (Set I). Variables 1 to 13 reflect structural measures, while variables 14 through 18 reflect process and context components. Since Dr. James has discussed these measures, I will not take the time to review them here.

IC and Joint IC-S. In Sets II & III, an important distinction has been made between variables representing individual characteristics such as intelligence, marital status, education and age, which are relatively independent of the organizational situation, and a second class of attributes which are typically joint functions of the larger organizational situation, the individual, and in some cases, the subsystem situation. For example, a minimum GCT is required before a person may take certain schools, apply for particular job types, and so forth. Other schools may be offered only to persons who have been in the Navy or other organizations for a particular time. Level is another variable of this type, where the organization sets criteria for promotion including specified experience and achievement levels, and provides role requirements and privileges for each level. On the other hand, the individual must possess certain abilities and aptitudes and must decide whether to remain in the organizational setting and strive for higher levels. The identification and use of this Joint Individual-Situation class of variables is intended to avoid some of the confusion which arises when a variable such as level is used both as a structural variable (as for example, by Porter & Lawler, 1965) and as an individual characteristic variable. Relationships between variables in this class and work group or situational characteristics are expected to depend on aspects of the organization. For example, the overlap between job type and

situation would probably be greater if workgroups or divisions consisted entirely of one or more job types not found in other workgroups of divisions.

The variables listed on the individual characteristic (IC) and the joint individual-situation (IC-S) classes of variables were obtained by self-report measures and from ship records. All of these measures are relatively straightforward except for the series of IC composites regarding Ego Needs (α=.59, 4 items), Self Esteem (α=.54, 4 items) and Preenlistment Disciplinary Record (α=.64, 3 items). Two other items were included in the IC domain -- size of house and the size of the town in which the person was raised.

Relationships of Situation, IC and IC-S to PC. The lower portion of Table 1 presents the results of comparisons of different sets of independent variables as these sets related to PC component scores. The first three sets of R's represent regressions for the situational variables; the remaining represent regressions for the IC and IC-S variables. When structure variables only (set I variables 1-13) were related to PC scores, the resulting R's tended to be modest, but within the range reported by others (Lawler, Hall & Oldham, 1974). The addition of interaction terms among variables within the structural subset increased the multiple R's as did the addition of variables from other components of the organizational model. F-ratios are not presented since all comparisons were significant at the .01 level. The relationships between PC and the IC and IC-S sets were of similar low to moderate magnitude except for the R's with Challenge and Variety. Interaction terms were not included for the IC and IC-S components since variables within each set were significantly inter-correlated.

In order to explore overlapping variances, selected subsets of the variables in each of the three components (Situation, IC and IC-S) were combined to predict PC. Table 2 presents both the selected variables and comparisons among

different sets of independent variables. Although the R's for sets I, II, and III were less than reported in Table 1, the loss appeared to be similar for all PC components except the Challenge and Importance component, which remained at the same level. This lack of change appears to be explained by the relationship of Challenge and Importance to age (r=.42) and paygrade (r=.50).

A comparison of multiple R's for each of the first three sets of independent variables with the combined sets indicated that although situation, individual characteristic, and joint individual-situation variables each accounted for some unique variance, the overlap across sets was high. This result however, is not uncommon in real life, where variables from conceptually discrete domains are so interrelated that after the first variable or set of variables is entered into a regression analysis, the addition of other variables tends only to chip away at the remaining unexplained variance. However, the data did suggest that some of the PC components are more sensitive to role-related influences, such as level, than to influences of the organizational sub-unit. In other words, for a PC component such as Challenge or Esprit, the situation influencing perception appears to be more a function of the subdomains represented by level or paygrade than of the division in which the person works. For other variables such as job standards, however, the relationship with organizational unit data appears to be greater.

These results would seem to call for a rethinking of the currently popular approach in which dimensions of the perceived situation are indiscriminantly averaged or accumulated without regard to the types of dimension involved. In the corresponding question of whether individual perception may be accumulated to represent situational attributes (as in the case of OC), the present data were inconclusive. Although the structural, process, and context variables were significantly related to PC, the overlapping variance among sets of independent variables was considerable. This might be

interpreted to rule out accumulating PC scores by organizational unit. However, the impact of level and a knowledge of shipboard life would suggest a different interpretation. On a ship, chiefs and first class seamen often have separate living spaces which would give a communality of situation (across organizational subunit) perhaps not shared by the average sailor whose work and berthing areas tend to be determined by his division assignment. Analyses currently in progress, separating E-6 and above (foreman rates) from E-5 and below should help to clarify these relationships.

Such questions are of considerable importance in deciphering the theoretical boundaries of the conceptual domains involved. Of equal importance and interest, however, is the question of how these domains affect attitudes such as job satisfaction and other measures such as retention on the job and promotion.

Relationship of Situational, IC, IC-S, and PC to Attitudes and Behavioral Criteria.

The final set of individual analyses explored relationships among the Situational, IC, IC-S, and PC domains with such dependent variables as stated Intent to Reenlist (a 5-point scale) Promotion Rate (paygrade standardized by time in Navy) and a 14-item overall Job Satisfaction Scale (α=.92). The analyses are summarized in Table 3, where the first four sets of results show the relationships of each set of independent variables to each of the criteria. The situational variables showed a low to moderate relationship with the criteria. The relationships for the Individual Characteristics and Individual-Situational variables were somewhat higher. The PC components were fairly highly related to satisfaction and intent to reenlist but only moderately to promotion rate. Except for the Intent to Reenlist criterion, the addition of one or more sets of independent variables failed to result in any appreciable increase in R over that obtained for the highest single set.

These findings would, at first, seem to be effects of level, leading to the frequently established conclusions that sailors who reenlist once tend to do so again, that they are more satisfied, and that they receive promotions in relation to duty time. The conclusions regarding promotion and reenlistment are supported by a comparison of the results for set 7 which contains age, level, and paygrade and set 8 in which these variables were omitted. Both reenlistment intent and promotion rate suffer a noticeable decrease in the R for set 8. For satisfaction, however, the decrease is considerably less than would be expected in view of the correlation between level and satisfaction (r=.35) found in the present study and others in the literature.

Although level is an important correlate of reenlistment and promotion rate, the size of the R remaining when level-related variables are omitted is still substantial. These findings would seem to indicate that even though level may be correlated with various criteria, an overemphasis on level and level-related variables might obscure important relationships of considerable practical and theoretical interest.

Finally, it is noted that PC shares a considerable amount of variance with satisfaction which does not appear to overlap with variance attributable to the other sets of independent variables.

Organizational Analyses

The next set of analyses were organizational in focus and explored relationships between structural and context measures, subgroup climate (measured by average or mean perceptions of climate), and organizational performance.

Organizational performance was measured by having each department head rate the divisions under him, approximately six months after the structure, context, and perceived climate measures had been collected. These ratings were

developed by means of a modification of the behaviorally based expectations technique described by Smith, Kendall & Hulin (1969). Interviews with Navy Officers were used to derive eight dimensions of major importance to effective functioning by departments and divisions. For each dimension, the officers suggested three general incidents or types of behavior--one which reflected poor performance on the dimension, one which reflected average or adequate performance on the dimension, one which reflected average performance. These twenty-four statements were then mixed in an attempt to reduce the influence of one rating upon subsequent ones.

The rater was asked to indicate whether the division as a whole would be expected to perform worse than, equal to, or better than each of the twenty-four statements. The rated division received a score ranging from 3 (if rated worse than each of the statements) to 9 (if rated better than each of the statements). A score was given for each of the eight dimensions.

Table 4 shows the predictive validities for each set of predictors. The structural variables in Set I are the same as were used in the individual analyses. The second set of predictors (reflecting subgroup climate) consisted of division means, for the four PC components which were most highly determined by situational variables. The Challenge and Esprit components were not accumulated due to the correlations with variables such as level or tenure which cut across organizational units.

I would again like to stress that the validities in Table 4 are predictive validities in which ratings of organizational performance were predicted from structure, context and subunit climate measures gathered six months earlier. Both the structure and context, and climate variables contributed unique variance, although the R's for structural and context variables by themselves were only at the .10 level. When both structure and context are added to climate

variables, the level of predictive validity for a number of the criteria is good since predictions of individual criteria seldom exceed .50. This figure might be used as a frame of reference for the present predictions of organizational criteria. The criteria themselves are only moderately interrelated with an average correlation of .40.

Summary:

The analyses presented here have examined a few of the potential relationships implied by a comprehensive, integrative model. In contrast to the clarity of the within component analyses (James & Jones, 1974),the intercomponent analysis presented here are more difficult to interpret. As suggested earlier, further analyses are in progress to clarify the implications of some of the results. On the other hand, even though numerous questions remain unanswered, several points appear indicated.

First, the direct relationship of structure to perception, satisfaction, reenlistment and promotion rate appears to be minimal. This finding, however, might be due to the considerable homogeneity of the present sample and might well be different in the other samples (e.g., shore stations, fire stations, etc.).

Second, there was considerable overlap of criterion variance accounted for by the several sets of independent variables. The correlation of each set with PC, however, varied depending upon the PC component under investigation.

Third, the variables in the IC-S category (e.g., level) appear to play a more important and complex role in defining the organizational situation experienced by the individual than has been recognized in the past.

Fourth, some support was found for the idea that PC is an intervening psychological process representing interactions between the individual and the situation and PC reflects more than a summation of situational variables.

Finally, variables from the subunit climate and the structure and context domains were effective predictors of later ratings of organizational performance, indicating the influence of such components on organizational as well as individual behavior. Further analyses will investigate the role of climate in relationship to other components in terms of influence of given scores upon individual attitudes and behavior as well as organizational behavior.

Table 1

Relationships of Psychological Climate with Situational, Individual Characteristics and Individual — Situational Interactive Variables for US Navy Enlisted (N=3726).

I. Situational	II. Individual	III. Individual-Situational Interaction
1. Ship Size	1. Age	1. Level-Paygrade
2. Division Size	2. Married	2. Time in Navy
3. Specialization	3. Years of Education	3. Time in Paygrade
4. Span of Control	4. GCT	4. Amount of Sea Duty
5. Configuration-Levels	5. Ego Needs	5. Number of Men Supervised
6. Tall/Flat	6. Self-Esteem	6. Time in Enlistment
7. Centralization-Overall	7. Pre-enlistment Discipline	7. A & B Schools
8. Standardization-Overall	8. Grades Failed	8. Other Navy Schools
9. Interdependence	9. Town Size-Child	9. Job Type
10. Formalization-Role Structure	10. House Size-Child	
11. Centralization of Work		
12. Formalization-Communication		
13. Standardization-Training		
14. Goals-Morale		
15. Goals-Standardization		
16. Process-Communication Down		
17. Context-Support		
18. Context-Technology		
19. 2x4		
20. 2x5		
21. 2x8		
22. 2x10		
23. 2x11		
24 2x12		
25. 7x9		
26. 8x15		
27. 4x7x10		
28. 7x8x10		
29. 3x8x15		
30. 7x8x12		
31. 3x8x15		
32. 7x12x18		
33. 12x16x18		

Regression Models

Sets of Independent Variables	R Against PC Component Scores					
	Conflict & Ambiguity	Challenge, Importance and Variety	Leadership Effectiveness	Workgroup Cooperation	Esprit de Corps	Job Standards
Structure	.11	.22	.12	.22	.15	.19
Structure & Interdependence	.16	.25	.16	.28	.21	.22
All Situational	.18	.25	.17	.31	.24	.25
Individual	.15	.46	.10	.26	.31	.19
Individual Situational	.15	.52	.10	.27	.28	.14

Table 2

Relationships of Psychological Climate Scores with Selected Subsets of Situational, Individual Characteristic, and Joint Individual-Situational Variables

I. Situational	II. Individual	III. Joint Individual-Situation
1. Division Size	1. Age	1. Time in Navy
2. Specialization	2. Education	2. Paygrade
3. Span of Control	3. GCT	3. Time in Paygrade
4. Configuration-Levels	4. Ego Needs	4. Number of Men Supervised
5. Centralization	5. Esteem	5. A & B Schools
6. Standardization	6. House Size-Child	6. Other Training Schools
7. Interdependence	7. Disciplinary Record	7. Job Type
8. Formalization-Role Structure		
9. Goals Standardization	IV. Interactions Across Variable Subsets	
10. Technology		
11. Size x Specialization	1. Formalization x paygrade	
12. Size x Centralization	2. Formalization x Self Esteem	
13. Specialization x Formalization	3. Centralization x paygrade	
14. Specialization x Technology	4. Technology x A & B Schools	
15. Standardization x Technology	5. Standardization x Self Esteem	
16. Special. x Stand. x Goals Stand.	6. Standardization x GCT	
17. Central. x Goals Stand. x Technology	7. Ego Needs x Paygrade x Formalization	

Multiple R's Against PC Component Scores

Independent Variables	Conflict & Ambiguity	Challenge, Importance and Variety	Leadership Effectiveness	Workgroup Cooperation	Esprit de Corps	Job Standards
Set I	.13	.23	.14	.28	.16	.22
Set II	.13	.46	.09	.26	.30	.19
Set III	.12	.52	.10	.26	.26	.13
Sets I & II	.18	.48	.16	.35	.33	.29
Sets I & III	.18	.54	.17	.33	.29	.26
Sets II & III	.16	.54	.11	.32	.32	.22
Sets I, II, III	.20	.56	.17	.38	.35	.31
Sets I, II, III & IV	.21	.56	.18	.38	.36	.31

TABLE 3

Relationships of Selected Subsets of Situational, Individual Characteristic, Joint Individual-Situational Variables and Psychological Climate Component Scores with Selected Individual Criteria

Sets of Independent Variables	Multiple R's Against Criteria		
	Intent to Reenlist	Promotion Rate	Overall Job Satisfaction
1. Situation	.16	.28	.22
2. Individual Characteristics	.67	.32	.36
3. Joint Individual-Situation	.67	.80	.33
4. Psychological Climate	.56	.26	.69
5. Situation + Individual	.67	.39	.40
6. Situational + Joint Indiv-Sit.	.67	.80	.37
7. Individual + Joint Indiv-Sit.	.69	.80	.39
8. Individual + Joint Indiv-Sit. (w/o age, paygrade, duty time)	.51	.45	.35
9. Situation Individual + Joint Individual-Situation	.69	.80	.41
10. Situation + Individual + Joint Individual-Situation + PC	.75	.81	.70

Table 4

Prediction of Division Performance Ratings By Structure, Context, and Subsystem Climate Measures (N=161)

I. Structure & Context

1. Division Size
2. Specialization
3. Span of Control
4. Configuration - Level
5. Goals Standardization
6. Centralization
7. Standardization - General
8. Interdependence
9. Formalization - Role Structure
10. Technology
11. Size x Specialization
12. Size x Centralization
13. Specialization x Formalization
14. Specialization x Technology
15. Goal Standardization x Standardization
16. Specialization x Standardization x Goal Standardization
17. Goal Standardization x Centralization x Technology

II. Climate

1. Conflict & Ambiguity
2. Leadership Effectiveness
3. Workgroup Cooperation
4. Job Standards

III. Across Component Interactions

1. Span of Control x Leader Effectiveness
2. Standardization x Workgroup Cooperation
3. Formalization x Workgroup Cooperation
4. Technology x Job Standards

	Multiple R's Against Performance Ratings							
Predictors	Quality of Work	Readiness to Fulfill Commitments	Performance Under Pressure	Efficiency	Relationships With Other Divisions	Safety	Leadership	Maintenance
Set I	.34	.38	.36	.38	.38	.29	.35	.35
Set II	.34*	.39*	.34*	.29*	.33*	.26*	.22*	.33*
Sets I, II	.45*	.50*	.43*	.44*	.47*	.41	.40	.43*
Sets I, II & III	.47*	.51*	.43*	.46*	.48*	.42	.41	.45*

*$p < .05$

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PHYSICAL ENVIRONMENTS, HABITABILITY PERCEPTIONS, AND HEALTH

E. K. Eric Gunderson

The physical environment is viewed as an important component of the social system model. The environment has an impact at several levels of analysis and interacts with all other components to influence behavioral outcomes.

Reference to the external physical environment in the model indicates that an organization is an integral part of an ecological system and is affected by the surrounding natural terrain, climate, hazards, atmospheric pollutants, noise, energy and power sources, transportation systems, neighboring buildings and structures, nearby community facilities, and many other geographical and environmental factors.

The organizational physical environment consists of the buildings, structures, and the interconnecting or contiguous spaces where the organization's business is conducted and normal activities are carried out.

The group physical environment refers to the space occupied or used by a particular subunit of the organization. Aboard ship, work spaces or sleeping compartments are examples of this level or unit of analysis.

The environmental dimensions that are commonly applied to the description of organizational or group physical environments include: spatial size, temperature, ventilation, noise, illumination, color, cleanliness, odor, design of fixtures and furnishings, privacy, storage space, and safety factors.

These dimensions can be used to characterize the organizational environment as a whole, or, if significant variability is present, to differentiate among work areas or spaces within the total organizational environment. Most of these environmental dimensions can be assessed directly by measurements or objective ratings and comparisons.

Another approach to assessing environmental dimensions involves ratings by the inhabitants or occupants of the spaces. These habitability perceptions partly reflect attributes of the "real world" and partly reflect psychological processes within the individual. We have used both of these methods of assessing environments in our shipboard studies. In this paper I shall be primarily concerned with crew members' perceptions of their working and living conditions.

The major environmental dimensions and response categories used to describe shipboard living and working conditions are shown in Table 1 of the handout. This example applies to the crew member's work area; similar scales were provided for the individual to rate his berthing (sleeping) area, messing (eating) area, head (bathroom) facilities, and the ship as a whole. The crew member also was asked to rate how important each of the environmental factors was to him personally. These items were included in the Habitability and Shipboard Climate Questionnaire which was administered to approximately 70 to 80 percent of the crew members of the ships early in their overseas deployments.

The following dimensions were combined for purposes of estimating conditions on the ship as a whole: temperature-ventilation, cleanliness-odor, size-number of people, lighting-color. The remaining dimensions --

privacy, noise, and safety -- were treated as separate variables. Individual scores were obtained for each of the seven habitability scales by summing response values for the four specific areas mentioned above and for the entire ship. Thus, the individual's score for the size-number of people composite represented his perceptions of crowding in the spaces that he occupied on the ship.

Table 2 of your handout shows a classification of ships by age and physical characteristics and the mean perceived habitability scores for the 15 ships included in the grouping. The four categories of ships reflect similarities in ship type, physical size and tonnage, dates of commissioning and conversion, structural design or class, and habitability characteristics.

The ships in Class A were all destroyers commissioned in 1945 and 1946. The basic hull design, structural configuration, and crew accommodations are typical of destroyers built during World War II, based upon the technology and habitability concepts of the late 1930's and early 1940's. Although "modernized" in 1960, this conversion was directed primarily toward modernizing weapons and electronics systems. The mess, berthing, and sanitary facilities remained essentially the same except that air-cooling units were installed in messing and berthing areas.

Ships in Class B were guided missile destroyers of the same class built in 1963-1964, and ships in Class C were guided missile frigates of the same vintage, but somewhat larger than the destroyers. The ships in Classes B and C, when compared with ships in Class A, incorporated some advances in habitability design. The ships in Group D were all destroyer-escorts of the same class and were among the most modern U.S. combat ships afloat.

Crew sizes ranged from approximately 220-270 men for the destroyers and destroyer-escorts to about 350-390 for the frigates.

Of the 20 ships in the total sample studied, three (a destroyer, a guided missile destroyer, and a destroyer-escort) did not fall within the specific classes represented by the four subgroups, and these ships were omitted from the comparisons below. Also, two aircraft carriers in the total sample were omitted from consideration.

Table 2 shows the arrays of mean perceived habitability scores by ships and by dimensions. There was virtually no overlap in mean scores from one ship class to another on the crowding and privacy dimensions. The mean crowding score for the least crowded ship (26.8) was more than one and one-half standard deviations higher (more favorable) than that for the most crowded ship (18.3).

On the other dimensions there tended to be some overlap from one ship class to another, but generally more favorable perceptions of habitability were typical of the newer ships. Thus, Class A ships were perceived as being hot, dirty, crowded, and unsafe compared with Class D ships.

Illness data were collected throughout the 7-8 months of the overseas deployments using individual cards which contained identifying information, type of illness, and disposition. These special illness records, instituted for the purpose of this research project, were accumulated to provide illness criterion information for individuals, work groups, berthing compartment occupants, and ships.

Table 3 provides an analysis of differences between ship classes on habitability scales and on illness criteria. Analysis of variance results are

presented in terms of the variance accounted for between ship classes as compared with the variance remaining among ships within classes. For the habitability dimensions it is clear that differences between classes tend to be large and to account for a large share of the total variance among ships. This result indicates a high degree of consensus as to physical environmental differences between the ship classes and suggests that the perceived habitability scores reflect real attributes of the shipboard environment.

Differences in illness rates were accounted for to some extent by differences between ship classes, but this effect was much less pronounced for illnesses than for habitability perceptions. Gastrointestinal disorders had the strongest association with ship class, that is, poor habitability conditions (presumably sanitation, etc.), and this relationship was linear. Dermatological conditions also were more common on Class A ships than other ships, and the total illness rate (excluding genitourinary or V.D. cases) was highest for the Class A ships.

Respiratory illnesses did not conform to the general pattern of other types of illness in that the newest ships (Class D) had the highest rate of respiratory infections while Class B ships had the lowest rate. At the same time it is noted that the Class D ships, which had central air-conditioning with recycled air, were most comfortable. The relationship between type of ventilation system and respiratory illness is being investigated further in a special study of seven of the ships in the sample: it is apparent that there is no simple relationship.

In the next step of the analysis, perceived habitability scores were correlated with the illness criteria with the between-ship-classes portion of

the variance removed. Using this procedure, temperature-ventilation, cleanliness-odor, noise, safety, light-color, and total habitability score, which was a summation of dimension scores, correlated significantly in the expected direction with the total illness criterion. In other words, the remaining variance in habitability perceptions within ship classes contributed further to the prediction of illness, although these correlations were low (about .10).

These results suggest that differences in actual physical characteristics of ships and differences in perceived habitability both contribute in small degree to the prediction of illness.

In the earlier pilot study of 1,200 men on 13 ships significant differences in perceived organizational climate were found among three types of ships.[1] Profiles of scores on five factors of organizational climate -- friendliness and warmth of the work environment, job identification, leadership effectiveness, group homogeneity, and job standards and demands -- were found to be related to differences in ships in relation to their location (overseas or continental U.S.), illness rates, and performance indices. A pattern of organizational climate was found which was associated with high illness and accident rates, high disciplinary rates, and low rate of intention to reenlist.

One of our objectives as stated earlier is to specify the portions of criterion variance accounted for by various major components of the model -- physical environment, perceived habitability, organizational structure, perceived organizational climate, individual resources -- and by interactions of these components. We have already shown that certain of the major model components -- physical environment, habitability perceptions, and organizational

climate -- separately make contributions to the prediction of such criteria as illness and job satisfaction. We now have the difficult task of integrating all of this data in order to support or refute major propositions implicit or explicit in our social systems model.

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Table 1

Habitability Dimensions

"FOR EACH OF THE CONDITIONS BELOW, CHOOSE THE LETTER WHICH COMES CLOSEST TO DESCRIBING THE WAY THINGS ARE IN YOUR WORKING AREA."

LIGHTING	TOO DIM	a	b	c	d	e	TOO BRIGHT
TEMPERATURE	HOT	a	b	c	d	e	COLD
VENTILATION	POOR	a	b	c	d	e	GOOD
CLEANLINESS	DIRTY	a	b	c	d	e	CLEAN
ODOR	UNPLEASANT	a	b	c	d	e	PLEASANT
SIZE	CRAMPED	a	b	c	d	e	ROOMY
NUMBER OF PEOPLE	CROWDED	a	b	c	d	e	UNCROWDED
COLOR	UNPLEASANT	a	b	c	d	e	PLEASANT
PRIVACY	NONE	a	b	c	d	e	PLENTY
NOISE	EXTREMELY DISTURBING	a	b	c	d	e	NOT BOTHERSOME
SAFETY	HAZARDOUS	a	b	c	d	e	SAFE

Table 2

Ship Characteristics and Mean Perceived Habitability Scores

	Class A Destroyers			Class B Missile Destroyers				Class C Missile Frigates			Class D Destroyer Escorts				
	1	2	3	1	2	3	4	1	2	3	1	2	3	4	5
Commissioning/ Conversion dates	1945/ '59-60	1946/ '59-60	1945/ '59-60	1964	1963	1963	1964	1963	1966	1964	1970	1970	1970	1970	1970
Habitability Dimensions[a]															
Crowding[b]	18.3	19.7	20.3	20.6	21.2	21.3	22.0	22.0	23.7	24.1	24.1	25.2	26.2	26.7	26.8
Temperature-Ventilation	20.9	21.2	24.5	21.4	21.3	23.2	18.5	24.1	25.6	23.5	26.9	22.9	25.2	24.4	27.2
Cleanliness-Odor	26.5	25.7	25.7	26.2	26.3	27.9	26.1	27.4	28.9	27.2	29.5	27.3	29.6	30.3	30.9
Noise	11.5	12.7	12.7	12.4	12.1	12.8	12.7	11.7	12.5	12.0	13.4	13.3	13.3	14.0	13.8
Safety	14.1	15.4	14.9	14.4	15.0	15.5	15.8	15.7	16.0	16.0	16.5	16.2	16.7	17.3	17.1
Privacy	6.4	6.7	6.6	6.7	7.1	7.1	7.3	7.5	7.5	7.4	8.0	8.8	8.5	8.5	8.9
Light-Color	25.7	25.3	26.0	26.2	25.3	25.0	26.5	25.7	25.8	26.8	26.5	27.4	28.1	27.5	28.4

[a]Individual scores were obtained by summing responses for each habitability dimension over five ship areas: working area, messing area, berthing area, heads or sanitary facilities, and the entire ship. Mean scores were then obtained for all crew members tested on each ship.

[b]Combines "Size" and "Number of People" items.

Table 3

Ship Class Means and ANOVA Results for Habitability Scores and Illness Criteria

	Mean Habitability Scores[a]				ANOVA Results	
Habitability Dimensions:	Class A	Class B	Class C	Class D	Between Ship Classes[b]	Within Ship Classes[b]
Crowding	19.3	21.2	23.1	25.6	83.2	5.6
Temperature-Ventilation	22.7	20.8	23.7	25.2	52.8	14.4
Cleanliness-Odor	26.1	26.5	27.3	29.3	26.2	4.6
Noise	12.1	12.5	11.9	13.6	23.0	2.1
Safety	14.5	15.2	15.9	16.7	25.6	3.1
Privacy	6.5	7.0	7.4	8.5	45.2	1.9
Light-Color	25.8	25.9	26.3	27.4	9.0	2.7
Total Habitability	127.2	128.7	135.8	146.0	58.7	2.9
Illness Criteria:[c]						
Respiratory	5.0	4.2	5.4	6.0	12.0	11.9
Dermatology	4.1	2.8	2.9	3.0	4.2	3.9
Trauma	2.1	2.0	2.1	1.7	1.5	5.7
Gastrointestinal	3.5	2.8	2.0	1.5	19.7	10.8
Total Illness[d]	18.2	15.0	17.3	15.1	5.3	13.9

[a]High scores indicate favorable habitability

[b]F-ratios; df between classes equals 3 and df within classes equals 8.

[c]The number of initial dispensary visits per 1,000 men per day. One ship was dropped from Class A, Class C, and Class D because of incomplete illness reporting.

[d]Genitourinary infections were not included.

COMMENTS ON MEN IN SOCIAL SYSTEMS: RESULTS OF A THREE-YEAR MULTIORGANIZATIONAL STUDY

CDR Paul D. Nelson, MSC

The difficulties of conducting well-designed field studies of human behavior are known to us all. When one compounds such difficulties with those also inherent in longitudinal research and, in the present instance particularly, with the study of mobile men and organizations as has been done in our research aboard ships at sea, the effort of the present speakers and the institutions they represent must truly be applauded. A footnote of appreciation should also, of course, be expressed to the many Navy line officers, medical officers, and sailors whose partic . tion and cooperation, under schedules and workloads demanding enough in their own right, have made these studies at all possible.

To comment in detail on problems of design in this research or of continuities and discontinuities in theory and data offered by Dr. James, Dr. Jones, and Dr. Gunderson would not, in my opinion, be time well spent at this symposium. It would be in fact premature, if not unfair to the speakers, to do so since extensive consideration has been given such matters by the investigators and the data have just been collected. The importance of this research, as suggested by Dr. Sells in his opening remarks, lies in the skillful and all-too-rare integration of social psychological theory with the resolution of practical problems. Since Dr. Gilmer has so succinctly addressed his comments to the theoretical significance of the

research, I will restrict my few remarks to the practical implications of the work.

First of all, while the three-year life-span of this study might appear long to many, I regard it as but an interval in a much longer and broader program of research conducted by the Navy. For the background of this study, indeed many of the specific design characteristics, reflects a continuous and iterative program of research of more than a decade and I feel certain, as research goes, that its results will in part dictate research of the future. If one carefully reviews the history of human behavioral problems in the military context, allowing for some cyclical variations of the times, one is almost certain to find today's problems and concerns - - - be it the adjustment of men to military service, their career motivation and retention, their health and safety, and their effectiveness in socio-technical systems - - - not totally different from those experienced by military planners and operational units of the past. And, while previous research has in many instances yielded important information, if not partial solution, to those problems, it has quite frequently erred in its guiding philosophy in two ways. First, we have all too often attempted to solve highly complex problems of human behavior with short-term, simple, and "head-on" (though face valid) strategies of research. Secondly, though related to the first, we have often failed to build on what we learn as we move along in an iterative model of research conducted longitudinally with increasingly successive approximations to the resolution of our problems as a goal. The present study, in its historical context, is a refreshing exception to that history of research. It has been neither conceived nor executed on the basis of fads or fashions - - -

or more pragmatically on the basis of "where the buck is" - - - but rather as a natural extension of previous research on seemingly timeless problems, and some new ones too, which face the military services.

Take for example the problem of the psychiatric adjustment of young men (and some older men too) in military service, a problem which has for decades represented a major cost to the military. During the 1960's some of Dr. Gunderson's colleagues at the Navy Medical Neuropsychiatric Research Unit, notably Dr. John Plag and Dr. Newell Barry, conducted extensive research on cohorts of sailors and Marines over the four-year duration of their first enlistment, a principal goal of that research being to develop improved strategies and techniques for the psychiatric screening of recruits. A great amount of information on the health and behavior of first-enlistment personnel was gained from those studies and standardized actuarial guidelines were developed for use by recruiters in estimating, from pre-service characteristics, the likelihood of effective service among recruits. Those guidelines are now employed in the Navy. The predictions of effective service adjustment which form the basis for such guidelines, however useful they might be for screening decisions among large cohorts of naval service applicants, remain of course quite modest. They are based primarily upon information about the individual and to a much lesser extent upon information about the interactions of individuals with the qualities of service environments in which they serve.

Let us suppose then, as our theory might allow us to do, that psychiatric adjustment to service reflects an interaction between person and environment. Let us also assume that there is a differential psychiatric risk across

different naval duty environments, which might reflect something about the individuals assigned to those environments but also, quite possibly, about the person-environment interactions associated with such duty. Dr. Gunderson has data, not discussed at this symposium, which clearly denote difference in the incidence of psychiatric casualties across different types of naval duty environments; thus my speculation is more than casual at this point. Now if there is indeed a person-environment interaction effect predictive of psychiatric adjustment, such that sailors with an initially marginal prognosis of effective service might be better supported in some duty environments than in others, we have some very real possibilities for improving our assignment strategies. Even when this effects but a small proportion of our personnel, it could be of considerable significance in times of manpower shortages and, even more important, it might enable some individuals to be effective workers for the first time in their lives. In other words, we have an opportunity to help individuals mature and become more effective citizens through their military service. The present study allows us to analyze such variables of physical and social environment as might conceivably interact with individual characteristics of young sailors in relation to service adjustment. This has yet to be done, of course.

Let's take another problem more specifically addressed in the present symposium, namely that of reenlistment or career retention, a problem currently of great importance in the Navy and other services as well. Dr. Jones' data suggest that characteristics of the individual and his success in the Navy to date are correlated with expressed intent to reenlist and this relationship can be slightly strengthened by including reference to the psychological climate

and situational variables of the organization in which the individual works. While there may be some confounding of variables in this relationship (for example, age, pay grade, and years of service probably reflect career commitments already made), and the present data analyses do not allow time - lag comparisons of reenlistment intent and the organizational climate experienced, it is interesting and perhaps important to speculate on the possible person - environment interactions related to career decisions. It is vital to note, however, that "intent to reenlist" was the variable measured in this study, not actual reenlistment. There is a difference. And though previous research has suggested "intent to reenlist" to be the best single predictor of actual reenlistment, the relationship is far from perfect. What are the intervening situational or person - environment interactions which modify the relationship between "intent to reenlist" and actual reenlistment? We don't know. They probably include, of course, variables not measured in the present study, such as alternative opportunities, life goals, personal influence of peers and superiors (or outside friends and family). Nevertheless, such variables as organizational or psychological climate experienced in different naval duty assignments might for some sailors be important intervening variables in the process of making initial reenlistment, if not full career, decisions. Such may be especially true for individuals in selected naval occupations seen as challenging to the man and for which an economic market outside the Navy may be less than optimal at any given time. Perhaps a sample of the first-enlistment sailors on whom data were collected aboard ship in the present study should be followed over the next year or two, so as to determine the actual reenlistment decision made and possibly some of the other variables related

to that decision.

The variables of health and shipboard habitability, examined in the paper by Dr. Gunderson, are extremely important to the Navy from several points of view. There is a great deal of activity in the Navy today devoted to improving the habitability of ships, modifying active vessels and designing new ones for the future. Personal comfort, architectural aesthetics, and safety are criteria of interest. While I am personally less persuaded than some that cosmetic surgery on ships will be a major contribution to improved career retention, I am convinced from extensive studies aboard ship that human factors design problems can be alleviated to improve safety and performance effectiveness. The work Dr. Gunderson and his staff, such as Lieutenant Larry Dean, are doing on actual and perceived conditions of habitability is being closely coordinated with the Naval Ship Engineering Center principally responsible for the design of ships.

The health criterion addressed by Dr. Gunderson is also vital to the Navy and is the interest which got us into the at-sea environment in the first place, some years ago. By and large, our ships' crews are a fairly healthy population. But when manning strengths are limited and ships maintain a continuous 24-hour operational cycle, it is extremely important that the crews be continuously as fit as possible. Another problem we face is the shortage of physicians in the fleet. Anything we can do to prevent illness and injury during ship deployment or to predict when such events are more likely to occur so as to improve our medical manpower and facility distribution in the fleet will be cost-effective. Dr. Richard Rahe, another colleague of Dr. Gunderson,

has for several years explored the matter of life stresses as precipitating events in the etiology of illness and accidents. One notion here is the possibility of developing a pre-deployment health screen, a possibility since a relatively small proportion of any given crew can be expected to incur a major portion of the health problems at sea. Dr. Gunderson, of course, is also interested in the way in which stresses of the physical and social environment at sea might interact with pre-deployment life stresses experienced by the individual resulting in illness or accidents.

In addition, Dr. Gunderson and his staff have gradually developed, over several years now of shipboard studies, a profile of the incidence of different types of health problems over the various phases of deployment cycles in different classes of ship. Reliable information of that nature has been greatly needed by the Navy Medical Department for some time.

My final comments have to do with the implications this study might have for major systems performance evaluation, a note on which Dr. Gilmer ended in his thoughtful commentary. During the last several years we have, again through coordinated effort of the Bureau of Medicine and Surgery and the Office of Naval Research, conducted extensive research on aviator landing performance aboard aircraft carriers at sea. The flight squadron and its aviators are of course the raison d'etre of the carrier and landing performance remains one of the highest risk phases of flight operations. Having now developed a standard reliable measure of landing performance efficiency, through the contract efforts of Dr. Clyde Brictson of Dunlap and Associates, we are able to longitudinally evaluate the performance (on that critical phase

of flight) of aviators and flight squadrons. We have already examined the effects on performance of type aircraft, type carrier, weather and sea-state conditions, day or night flight, and aviator training performance. More recently we have additionally studied the possible effects of flight schedules and sleep loss on aviator performance.

In a broader social system context, could we not think of the possibility of examining organizational behaviors and climate variables which perhaps impact upon the efficiency of different sub-groups (i.e., divisions or departments) of the aircraft carrier crew (e.g., engineering, operations, maintenance) which in turn directly or indirectly support the aviators? Much more work remains to be done, of course, if such is to be accomplished, especially in developing good performance criterion measures for the aviator support groups and in teasing out the relationships across time between those elements of the carrier system's performance with the elements of the aviator's performance. The present study allows us to gain at least a better handle on the measurement of organizational climate and to some extent its correlated social system behaviors.

I have commented on ways in which the present study, both broad yet focused as it is, represents an extension of previous Navy research on several important problems of human behavior. It represents too, for more theoretical issues, an extension of Dr. Sells' longstanding interests and research in developing environmental taxonomies and comparative organizational/environmental studies. The study, then, is rich in its heritage, its perspective, and its potential for social psychological theory and the resolution of diverse Navy problems as well as in the quality of its investigators and their efforts.

COMMENTS ON MEN IN SOCIAL SYSTEMS: RESULTS OF A THREE-YEAR MULTIORGANIZATIONAL STUDY

B. von Haller Gilmer

When viewed in terms of historical perspective this multi-organizational study is more expansive than most organizational climate evaluations, embracing both macro- and micro- aspects of social systems. The study opens up some practical ways for both predicting and planning for climate change within spatially defined limits. The suggestions can well apply to some non-military situations as well as to the social situations aboard ship and shore installations. Somewhat unique is the detail with which health factors have been interrelated with job satisfaction measures. This progress report offers a useful model for "pulling it all together", emphasizing the compatibility between theoretical and applied goals.

The study of organizational climates is quite old, if we allow some measure of literary license in our look backward to the descriptions given by the early Greeks recorded in the translation of Aeschylus and Athens. In current times one will find that climate studies of industrial, educational, and some Federal Government organizations began in the early 1960's by such a variety of behavioral scientists as Argyris, Blau, Etzioni, Gellerman, Haire, Leavitt, Likert, Miller, Schneider, Sells, Tagiuri, and Wohlwill -- to name a few. Studies have ranged from descriptions of company personalities to the criticism-ridden system of the

United States Post Office, from the psychological conflicts of employees within the IRS to the old fraternal system of our Department of State, fraught with the underutilization of people's capabilities. It is a living system, says Argyris, where one will find those who have the desire and competence to make decisions and enlarge their responsibility may not do so because they are embedded in a restricted system, plagued with problems not unlike those found in universities where faculties characteristically give more effort and skill to talk than to effective action.

The study reported here extends the detail measures of such conventional dimensions of climates as size and shape, leadership patterns, communication subsystems, and structural variables. It is quite useful, for example, to have techniques for obtaining scores on individual perceptions of crowding. The number of people in a given space hardly suffices as a measure, what they do in the given space at a given time is important. Also important is "why" one is in that space in the first place.

The study has helped bring into focus the constraints on the range of behavior permissible in any given environmental context; on the qualities of the environment, such as under- or over-stimulation, crowding, or the severity of the psychological climate in terms of health hazards. The report here had demonstrated that behavior is directed in a variety of ways at particular attributes and characteristics of the physical as well as the psychological environment. This type of study is helping to better lay out methodology and define the growing field we now call environmental psychology, extending from the anthropology of space for ship's crews to adjustment of people in various job categories.

It has been documented over and over again that industrial executives survive stress better than others in the organization. Perhaps many of us would agree with the explanation that selection and competition eliminate along the way those who can't take it. But, does the same hold true, or is there other reason, that individuals working in physically demanding and hazardous environments survive differently according to their classification of blue-collar, white-collar, or some technical speciality?

Some other questions I see coming to the fore that relate to general psychology theory - Why is a large proportion of the variance in illness rates accounted for by differences between ships, although the specific attributes of ships explaining the variations in the illness rates were not clear? For interactional theory, is it not important, as the study shows, to ask what sets of variables are important in predicting behavioral outcomes of stated interest. What is the relative importance of temporary fluctuations, permanent changes or continuity in central clusters for observational interpretation?

In this study we find measures of individual perceptions of the environment which seem to affect health and safety, job satisfaction, and work efficiency. Why do we find this when these effects can be separated from the effects of individual personnel characteristics or organizational climate?

It may be that these studies point us in some new directions as we reconsider intrinsic- extrinsic aspects of reward systems? It may well be that many of the 5,000 or so reported studies of job satisfaction have really not contributed very much to our understanding of motivation. Maybe it is more important than we have thought that background factors are

important, What does the person "bring in" to the situation in terms of abilities, attitudes, skills, desires, understandings, and habits? Can we use organizational climate scores to better understand subgroups and subsystems?

I see this study contributing not only to certain specifics of model building, but also to giving us better guidelines for bringing people and task variables together. In terms of historical perspective I see this study offering encouragement to those who may wish to extend climate description toward the more difficult task of measurement and system building.

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San Diego, CA. 92152

Dr. Clayton P. Alderfer
Department of Administrative Sciences
Yale University
New Haven, CT. 06520

Dr. Milton R. Blood
Department of Psychology
University of California
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